BLOCK PLANS SHOWING ARRANGEMENTS OF CIRCULAR WARDS ON DIFFERENTLY SHAPED SITES.

Fig 1

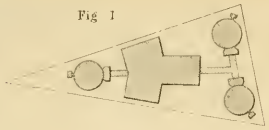


Fig. 2.

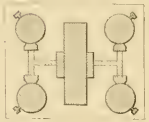


Fig. 3.

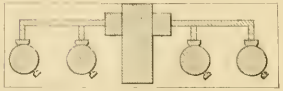
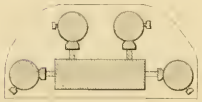


Fig. 4.



DIAGRAMS SHOWING THE RELATIVE SIZES OF A CIRCULAR WARD AND AN ORDINARY OBLONG WARD, FOR SIMILAR NUMBERS OF BEDS WITH SIMILAR WALL-SPACE PER BED_ VIZ: 18 BEDS WITH A WALL SPACE OF 9 FEET PER BED.

Fig. 6.

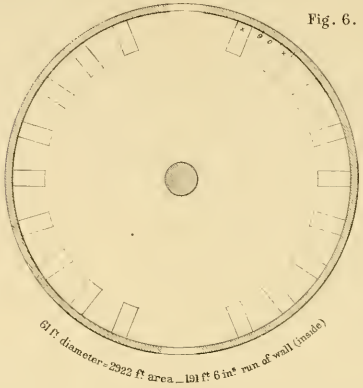
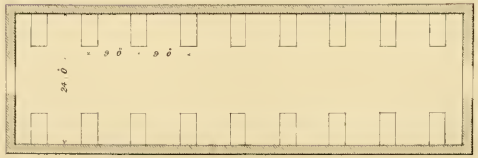


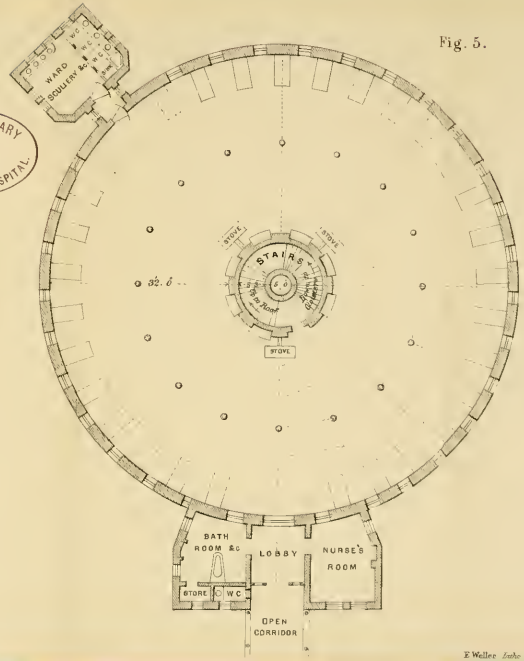
Fig. 7.



81 ft. by 24 ft._ 1944 ft. area 210 ft. run of wall (inside)

CIRCULAR WARD FOR 30 PATIENTS.

Fig. 5.



F G Smith Delin.
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ON A

CIRCULAR SYSTEM OF HOSPITAL WARDS

BY

JOHN MARSHALL, F.R.S. &c.

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With REMARKS and ILLUSTRATIONS

BY

PERCIVAL GORDON SMITH

ASSOCIATE OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS, ETC.

Read at the Cheltenham Meeting of the National Association for the Promotion of Social Science, October 1878

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1878

PREFACE.

HAVING recently had my attention directed to the subject of Hospital Construction, I was led, whilst considering the various modes in which a certain

Full particulars as to the details of construction of Hospitals with Circular Wards may be obtained of Mr. FRANCIS E. JONES, Architect, 20 Cockspur Street, London, S.W.

whose zeal and kindness I am indebted for the commentaries on my suggestion which follow in a separate Paper, and which, as a skilled Architect, he is so well qualified to offer.

J. MARSHALL.

10 SAVILE ROW:
Oct. 1878.

PREFACE.

HAVING recently had my attention directed to the subject of Hospital Construction, I was led, whilst considering the various modes in which a certain site might be occupied with buildings suitable for wards, distinct from the administrative offices, to try a circular shape for the former. Immediately, certain advantages became apparent, and prolonged reflection served to strengthen my first impressions.

On communicating my views, as recorded in the following Paper, to my friend Dr. George Buchanan, of the Local Government Board, I received from him an introduction to his colleague, Mr. Percival Gordon Smith, of the same Official Department, to whose zeal and kindness I am indebted for the commentaries on my suggestion which follow in a separate Paper, and which, as a skilled Architect, he is so well qualified to offer.

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ON A

CIRCULAR SYSTEM OF HOSPITAL WARDS.

By JOHN MARSHALL, F.R.S.,

PROFESSOR OF SURGERY IN UNIVERSITY COLLEGE HOSPITAL, LONDON, ETC., ETC.

The chief aim of the successive efforts which have been made to improve the construction of Hospitals has been the convenient realisation of certain well-understood sanitary conditions; but the views and requirements of modern hygienic science have advanced so rapidly, that principles and recommendations of comparatively recent date have often been speedily superseded. In the elaborate American Reports on Hospital Construction, edited by Joseph Billings for the building committee of the John Hopkins Hospital, in Baltimore (1876), probably the latest opinions on this subject are embodied; and to these, as fairly representative standards of authority, reference is made in the following pages.

Besides the important questions to be determined in the erection of a Hospital, as to the suitability of situation, soil and aspect, it is evident that the essential considerations in the construction of the Hospital itself, are those which relate to *frontage*, *exposure to air and light*, the *wall space* and *floor space* allotted to each bed, the *cubic ward space* per patient, the *number of patients under one roof*, the

ventilation and *warming of the wards*, the *isolation of the wards* from each other, the *severance* of the *cooking places*, *sculleries*, *bath rooms*, *lavatories*, and *water closets from the wards*, and, lastly, the *detachment of the administrative from the sick department*.

In order to satisfy the conditions demanded under these several heads, the pavilion system has been devised, in which oblong wards are disposed in separate pavilions. The parallelograms formed by such wards are recommended to be from 24 to 30 feet in width, whilst their length should range from twice to four times their width.

What I now venture to propose is the adoption of a *circular form* for the wards, instead of that of a parallelogram. I do not find that the circular form has been employed in any existing hospital, nor am I aware that it has ever been suggested. Separate canvas tents or wooden huts have been arranged in circles as military field hospitals (Hammond Hospital, Chesapeake Bay), and an *octagonal* ward exists in the Bristol General Hospital; but I believe that the idea of a *Circular System of Hospital Wards* is novel. I propose here to set forth its pretensions, and invite discussion concerning them.

(*a*) As regards *freedom of frontage* to all quarters of the compass, a circular ward would be uniformly free, except at some small part connecting it, by means of an open, or partially open, corridor with other circular wards, or with the necessary offices and administrative buildings.

(*b*) As regards the access of *light* and *air*, a circular ward cannot be surpassed. It is strongly insisted on by Professor Jones (Billings' Reports), that 'an unlimited supply of air' to a ward 'is the *cardinal* consideration'; and, again, it is elsewhere stated (Oppert), that 'the worst wards are those where least air and light are provided,' and that 'a closed court with wards around it is the worst arrangement.' A circular ward is obviously the inverse of this last-named plan; and, moreover, having no blank ends like an oblong ward, its uniformly rounded exterior, receding from all adjacent buildings, would receive light, air, and wind from every direction.

(*c*) The amount of *wall space*, *floor space* and *cubic space*, for each patient, in a ward of any shape, may of course be regulated by adapting the number of beds to the dimensions of any given ward; but it will be found that a circular ward, unless it be a small one, offers decided advantages in each of these respects. To illustrate this, I will take, as an example, a ward circular in shape, and having an internal diameter of 61 feet (Fig. 6). Such a ward would give 191½ linear feet of internal wall surface, which would afford 8 feet of wall space for each of twenty-four beds, and 9½ feet for each of twenty beds. To obtain space for access to the ward, however, two beds must in either case be deducted, so that the accommodation would be reduced to twenty-two or to eighteen beds. Nevertheless as regards available wall surface the circular ward has the advantage; for to accommodate twenty-two beds in a parallelogram 30 feet in width, giving to each bed a wall space of 8 feet, would require 236 feet run of wall; whilst for eighteen beds, with 9½ feet of wall space to each, 231 feet of wall would be required, instead of 191½ feet, as in the proposed circular ward. This is explained by there being no available places for beds at the ends of an oblong ward. A comparative view of a circular and oblong ward, for eighteen beds each, is given in Figs. 6 and 7.

The total *floor space* in a circular ward 61 feet in diameter is 2,922 square feet, and this of course exceeds the space capable of being enclosed by an equal run of boundary wall arranged in any other regular or irregular figure. It would yield, for twenty-two beds, about 133 square feet of floor space for each, and for eighteen beds, 162 superficial feet for each. The floor space per bed in any oblong pavilion ward 30 feet wide, in which a wall space of 8 feet is allowed for each bed, is only 120 feet; so that the advantage of the circle is clearly obvious. A few years since, 84 superficial feet were regarded as an ample allowance for each bed; but according to Stephen Smith (Billings' Reports), 120 square feet are now demanded, and for certain special hospitals a still larger space is desirable. The circular ward system

affords the most economical mode of securing such a space, so far as linear extent of wall is concerned.

The amount of *cubical air space* for each patient necessarily follows the same rule, and would be relatively greater in the circular than in the oblong ward here supposed. Thus, the oblong ward, with 120 square feet to each bed, would give 1,800 cubic feet per patient, for a height of 15 feet; whilst the circular ward would afford, with the same height, either 1,995 cubic feet for each of twenty-two patients, or 2,443 cubic feet for each of eighteen patients. In special hospitals, any required amount of cubical air space could of course be obtained, either by an increase of height beyond 15 feet, or by diminishing the number of beds. In reference to the last point, it may here be observed that all authorities agree that the number of patients in a pavilion ward should never exceed thirty. Stephen Smith (Billings' Reports) would restrict the number to twenty. The alternative numbers proposed in the above-described circular ward are eighteen or twenty-two.

(*d*) In reference to *ventilation*, I venture to suggest that a circular ward would offer highly favourable conditions for the complete attainment of this 'cardinal consideration.' In contact with the air on all sides, save for about one-twentieth part of its circumference, where it would be united with its corridor or offices, and having its windows disposed at regular intervals around it, it would form a sort of facsimile of the *circular tent*, so efficaciously sanitary, because so completely detached and aërated. Horizontal currents of air would sweep more readily and uniformly around the external surface of a circular than an oblong building. For the purpose of *natural ventilation*, every such horizontal movement of the outer air would become available, from whatsoever quarter or side it came. Proper openings systematically arranged in windows or walls, and acting as inlets or outlets as the case might be, would admit air or allow it to escape on every side, the fresh air being conducted beneath, above, or between the beds. For *artificial ventilation*, a shaft or shafts would find a suitable place in the centre of the ward, and therefore equidistant from the

circumferential inlets; such shafts might be easily and conveniently made to work by some central heating apparatus, or by some central mechanical agency. The difficulties attendant upon ventilating a long ward would disappear. Sharp draughts across the ward, down draughts on the walls opposite and relatively near to open windows, deficiency of movement of the air with certain winds, and the unequal or opposing extracting power of two or more fireplaces, would not exist.

It may also here be mentioned that the large central area of a circular ward would serve to separate patients very widely from their opposite fellow-sufferers. In an oblong ward, 30 feet wide, the distance from the foot of one bed to that of the bed opposite to it is 18 feet; in a circular ward 61 feet in diameter, it would be 48 feet. In the former case, the mean distance of the middle beds from the remainder is about 26 feet; in the latter, the mean distance of any one bed from the rest is 32 feet. The quantity of air between the patients would of course be greater.

(*e*) As to the equable *warming* of a circular ward, it is obvious that a central source or sources of radiating heat would present the advantage of being equally distant from every patient in bed; the warming centre would be in reality a *focus*; and, moreover, such a disposition of the heating apparatus would facilitate the central movement of the air for the purpose of artificial ventilation. But, probably, warm water pipes would have to be introduced around the circumference of the ward, a matter of as little difficulty as in an oblong ward.

(*f*) The *isolation* of circular wards from each other, on the horizontal plane, would be accomplished readily by long and narrow connecting corridors, exposed to the air on both sides, and open or closed, as might be preferred in particular cases. The number and the mode of connection of the circular wards themselves would also vary in different instances.

(*g*) The number of circular wards placed one above the other might likewise be varied. One floor only would be preferable for fever hospitals, for example, or in situations

where ground space was of no consideration. But in towns, or on limited areas, two, or at most three, floors should be the limit. If three such circular wards as I have described were placed one above the other, a *circular Ward Tower* would be formed, containing either sixty-six or only fifty-four patients *under one roof.* I would prefer the smaller number. The severest standard (Billings' Reports) admits eighty or a hundred as the maximum allowable number under one roof, according to the nature of the cases admitted. The superimposed wards might be without *direct* staircase communication with each other, and might have such communication secured *indirectly* from the connecting corridors. The *basement* of such a circular ward might, of course, be constructed on dry arches—a point regarded of great importance by many—or, if partially used for dry and clean stores, might be intersected by wide and well ventilated passages; it would furnish suitable space for heating apparatus of any kind. On the *circular roof space*, occupied in the centre by smoke flues and ventilating shafts, a warmed day-room could be constructed, surrounded by a glazed corridor or winter garden, with an outer walk for the exercise or recreation of convalescent patients.

(*h*) The *internal administration* of a circular ward, including its supervision by sisters or nurses, would be very easy. Unusually ample space would exist for dining tables and seats for the patients, smaller tables for sisters, clerks, or dressers, and other conveniences. Moveable surgical tables and screens might be arranged to travel on a circular tramway. Opposite to the proper corridor entrance, a door opening into a balcony might take the place of a window. A circular ward could readily be subdivided by high or low screens or partitions; whilst the control of the lighting, either by daylight or sunlight from the outside, or by central lights from within, would involve very simple contrivances.

From its abundance of space, the curved lines of its walls, the perspective of its numerous and evenly disposed windows, and its generally diffused light, such a ward would, surely, be far more cheerful and agreeable to the eye, for both patients and attendants, than a long straight ward.

(*i*) The *disconnection of all ward offices* from a circular ward would be easy to accomplish. Placed outside the wards, on the corridors or elsewhere, such offices would be readily lighted and ventilated by intermediate passages or lobbies, having opposite windows. This of course would apply to nurses' rooms, ward kitchens, sculleries, lavatories, bath rooms, urinals, and water closets.

(*j*) Lastly, the *administrative buildings*, the residential and official adjuncts necessary to every important hospital, including operating theatres, clinical theatres, and the out-patient and dispensary department, would be arranged in *quadrangular blocks*, from which the *circular blocks*, or *Ward Towers* for the *in-patients*, would be more or less widely detached, being communicated with only by the open or partially open corridors. (*See* Figs. 1 to 4.)

The foregoing considerations appear to me to show that the suggestion of a circular form of wards deserves attention. If the conclusions I have arrived at are sound, they at least indicate certain advantages offered by that form for hospital wards; and those advantages are in the direction of sanitary improvement, comfort, and administrative facility.

I have considered the obvious alternatives of an *elliptical* or of a *polygonal* shape of ward. The former is objectionable on account of its double centre. The latter might be easier of construction than the circular form; but, besides the fact that with the same extent of wall it would enclose a less space than a circle, there are several objections to it. Beds being placed with the heads to the flat wall surfaces of the polygon, there would be angles or corners where no beds could stand; and, besides this, the feet of some beds would be too near each other. Moreover, no windows could be introduced at the angles of the polygon, which would fall between the beds. The ward would be less neatly and uniformly filled, lighted, and ventilated. The number and position of the beds could be less easily changed. There would be unoccupied, and probably dusty and comparatively stagnant corners. The circle is the most perfect figure in every respect. For purposes of lighting, warming, and ventilation; for isolation from other buildings, and for internal

comfort and easy administration, this figure is well suited; and if the covering of a given area with circular blocks seems to be wasteful of ground space, this very condition would contribute not a little to the constant and uniform aëration of the outer surface of the Ward Towers.

As regards various details, including the difficulty and cost of construction, I gladly refer to the interesting paper by Mr. Percival Gordon Smith, making, however, this general observation, that if the form of hospital wards here suggested be advantageous, no consideration as to difficulty or cost should, under suitable conditions, hinder its adoption.

In reference to the proposal to occupy the central space of the largest circular ward with a staircase communicating from floor to floor, I may remark that this has been made by Mr. Smith primarily with a view to economy of construction; but I should much prefer to have the centre of the 61 feet ward, at least, as free as possible, and without direct communication with other floors.

I may here add that, simultaneously with the writing of this Paper on the *General Principles of a Circular Ward System*, I prepared a set of sketches, to a scale, with a description showing how this system might be applied to the site of University College Hospital. These plans and elevations show four circular Ward Towers, each consisting of an arched basement, three stories of wards, accommodating 54 beds, and an upper glazed exercise- and day-room. The circular blocks thus formed stand at the four corners of a quadrangular site, and are joined by corridors to square-shaped administrative blocks, having the general form of a Maltese cross, and occupying the interval between the Ward Towers.

ON SOME

STRUCTURAL CONSIDERATIONS

IN REGARD TO THE

'MARSHALL' SYSTEM OF HOSPITAL WARDS.

By P. GORDON SMITH,

ASSOCIATE OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

In considering from the point of view of an Architect the system of Hospital Ward construction proposed by Professor Marshall, there appear to be several distinct features deserving of special attention.

Firstly, there is the subject of its adaptability to site.

Secondly, its adaptability to the special purposes of particular kinds of hospitals.

Thirdly, the facilities that present themselves in regard to its construction; and closely allied to this feature is the important question of cost of construction.

Fourthly, what must always claim the special attention of an architect when designing a building,—the general appearance of the proposed building, and the artistic results that are attainable under the system.

First, in reference to adaptability to site. It will be seen from the accompanying block plans, that whether the shape of the site be any form of triangle (Fig. 1), or a square (Fig. 2), or a parallelogram (Fig. 3), or have some irregular

shape (Fig. 4), whether it be broad or narrow, the circular-shaped ward blocks can always be arranged upon it at least as easily as ordinarily shaped pavilions. If more than one block have to be provided on each side, they can be approached by a corridor having short connecting corridors or covered ways communicating with each block, as in Fig. 3. All necessary isolation of one block from another will be obtained in a convenient way by making the connecting corridors entirely open at the sides and merely covered in by the roof.

But the site of a hospital involves other considerations than the mere position of the buildings upon a given area. Questions of aspect, of relation to air and sun, and also of neighbours' rights to light and air, have frequently to be solved by the architect. With ordinary longitudinal wards he is often tempted by considerations of site economy to place a ward-side full against a prevalent wind, of course making corresponding difficulty in equable ventilation; or to admit an excess of sunlight on one side while the other side gets none. With a circular ward there can be no questions of this sort. Subject to obvious ward management, the *maximum* possible equability is secured for the several parts of the ward; and wind from any single point of the compass, instead of ever impinging upon a single side, can only strike full face at some single point in the circumference. So again, as regards possible interference with adjacent rights, the circular form would appear certain to have advantages over the longitudinal form, since it would recede, not along a straight line, but along a curve from its point of closest proximity to other premises.

As regards the second feature, viz. the adaptability of the system to particular hospitals, I have nothing to add to Professor Marshall's description of his typical ward of eighteen beds, except to say that about that size would be most promising for the architect. But it will be convenient that I should consider from the constructive point of view the limits of size within which the arrangement could be conveniently carried into effect. It is, of course, not claimed for the system that it is well adapted for very small wards; for to give

in a small circular ward the same floor space per bed as in a large circular ward, an extravagant expenditure of wall space would be required, and indeed such disproportionate wall space would be wanted in order to prevent inconvenience from the convergence of the beds; otherwise the feet of the beds would be too close together. I do not think it would be either economical or convenient to make a circular ward for less thau about eight beds. In such a ward it would probably be necessary to give to each bed at least 10 feet of wall space. This with the requisite space for the entrance doorway and the doorway to the w.c. projection, would require a diameter of 31 feet, giving a circumference of 97 feet, which would afford 80 feet for the eight beds and 17 feet for the two doorways. Possibly a ward for six beds might be feasible—the diameter being 25 feet 6 inches would give a circumference of about 80 feet, and this would afford fully 60 feet for the six beds. The average floor area per bed in the 31 feet ward (for eight beds) would be 94 feet, and in the 25 feet 6 inches ward (for six beds) only 85 feet supercial. But to pass to the greater limit—I understand this to be an affair not only of construction, but of what is best in ward administration, and I find authorities speaking of thirty beds as the number which had better not be exceeded in a single ward. I need, therefore, not refer to wards larger than this, but propose to examine simply the adaptability of a circular ward to thirty beds (Fig. 5). Let 8 feet be the amount of wall space which it is desired to assign to each bed, and it will be found that a diameter of 84 feet would suffice to give this amount to each one of thirty beds, besides 24 feet additional for the necessary doorways. With such a diameter there would be not only the thorough separation between the feet of opposite beds gained by the circular system, but a quite unnecessary amount of central space. This suggests to the architect the advantage of utilising the centre for purposes of support, and also for purposes of access upwards and downwards, and of subsidiary ventilation. I do not think there would be any objection to the middle of the wards being occupied by a block, say about 20 feet diameter, containing a central air shaft, surrounded by a staircase giving

access to the roof (Fig 5). The floor area of such a ward would then be . . . . . 5,541 feet
less for the central block (20 feet diameter) . 314 „
leaving the net area of ward . . . . 5,227 feet
and this would give an average of 174 square feet of floor space to each bed. But while I have taken eight beds and thirty beds as the minimum and maximum limits for circular wards, I should very much prefer the size and number of beds to which Professor Marshall has referred in the ward he has described. The superiority of such a ward over a parallelogram-shaped ward having the same accommodation, as regards floor space in reference to the run of wall, is shown by Figs. 6 and 7.

Each block of wards, as shown in Fig. 5, might comprise on each floor, besides the ward, a nurses' room, with the necessary small cooking appliances, and sink for washing the various utensils used in the ward in connection with food, &c. This room would be in a projection from the block and occupy a uniform position—viz. adjoining the connecting corridor. A bath room too would probably find its most appropriate place near the ward entrance, and might be approached either from the ward itself or from the lobby or corridor. The other necessary projection from each block would be for the water closets, slop sinks, &c.; and the position of this may be at almost any point in the circumference. Hence it would not be difficult in most cases to place these offices to the north or east of the blocks, where, as is desirable, they would be least exposed to the sun.

With regard to the third, and for the purposes of the present paper the most important feature of the system, viz. the various questions of constructing circular wards, the first point to be considered will be that of ventilating and warming such wards.

Notwithstanding the success which has attended the system of introducing fresh air vertically into the middle of large rooms, on the principle of what are commonly known as Tobin's tubes, it would I think be found desirable in the case of circular wards, of large size at any rate, to depend

mainly upon the system of admitting fresh air through the external wall, and removing it from the centre of the wards. In advocating this principle, I do not wish to underrate the value of air tubes, air-chambered stoves, and other similar appliances, useful arrangements enough, and which would probably be found very eligible auxiliaries here. They can, however, be regarded only as auxiliaries towards securing the gentle and universal movement of air which it is desirable to have in every part of a ward. Moreover, if used at all, their horizontal air chambers should be so arranged as to be capable of frequent cleansing. Let me take this opportunity of pointing out how such horizontal air chambers usually allow dust and other unwholesome matter to accumulate, to the encouragement of vermin and the contamination of the air.

In arranging for the admission of fresh air through the external wall of a circular ward, I should regard it as a necessity to have openings in the wall both at the floor level and at the ceiling level. The apertures at the ceiling level would be permanently open; but, for the prevention of strong draughts, they might be made say twice as large on the inner face of the wall as on the outer face. A covering of perforated zinc might also be suggested, but as such a contrivance generally soon gets stopped with dust or soot, I should prefer leaving the aperture uncovered except by a grating to prevent birds from getting in. At the floor level I would have large openings, say 18 inches by 12 inches, one behind each bed, by means of which the lower portion of the wards would be kept well supplied with gentle currents of fresh air. These openings would be furnished with sliding shutters inside, so that they might occasionally be closed. In reference to these openings, it will be observed that, the wards being circular, they will be opposite all points of the compass; and, therefore, when the windward apertures could not be kept open without inconvenience, no inconvenience would be experienced from keeping the lateral and leeward apertures open. It will perhaps be said that such openings as I have just described will, in practice, rarely be opened at all. I know from

experience the difficulty which occasionally exists in inducing patients, and sometimes even nurses, to understand the necessity for keeping the most ordinary ventilators open; but of course if the superior officers of an institution desire it, it will be done. Openings such as I have described are provided in the wards of the London Fever Hospital; they are there kept open during almost all weathers, and the result is most satisfactory in every way, the wards being at all times sweet, notwithstanding their great width (nearly 50 feet).

In a circular ward I think it highly probable that, while some of the openings I have been describing would act as inlets for fresh air, there would always be some of them which would act as outlets; nevertheless, I think it would be desirable to provide some means by which the general body of ward air might be extracted from the middle of the ward. It would appear expedient to have in the middle of the ward a stack of flues in which would be the various smoke flues and vitiated air shafts. With regard to the latter, it would obviously be necessary to keep those from a ward on one floor quite independent of the flues from the wards on the other floors of the same block; hence the central stack of flues would have to be of sufficient size to take not merely the chimney flues but also the several vitiated air shafts from the respective wards. We will suppose a block of three stories of wards 61 feet diameter. From each of the three wards there would probably have to be at least four air-extracting flues, each having a sectional area of about 200 square inches. These flues would each have two apertures from the wards, so that in each ward there would be eight outlets for vitiated air in the central shaft.

In the case of a small ward, say 30 feet diameter, the system of central extracting ventilation would be different. If, as appears likely in a ward of that size, the central shaft could be dispensed with, there would arise the advantage of gaining central space, while a sun-burner might be fixed under a flue or shaft in the middle of the ceiling, and this, while affording artificial light, would at the same time constantly create an upward current and help to keep in movement the atmosphere of the middle of the ward.

Closely allied to the subject of ventilation, and scarcely less important, is that of warming the wards. It is my belief that systems of ventilation too often are said to have failed when they owe their failure not so much to any defect in the system itself as to an absence of a sufficient heating power in the building. In other words, the fresh air is supplied at too low a temperature. If ventilation is dealt with irrespective of warming, it is, in cold seasons, almost sure to be a failure.

It would seem that a circular ward, by reason of its shape, offers peculiar facilities for being effectually and equably warmed. In a parallelogram-shaped ward a fireplace may be provided at one end, and others at the side or in the middle, but it is inevitable under such arrangement, that while some of the beds are too close to the fire, others are too far away. In a circular ward the fireplaces might be in the centre, equally distant for all practical purposes from all the beds; and I appeal to those who have experience of the inner life of a ward whether this would not be a considerable gain. In the case of a large circular ward, fireplaces in the centre would alone probably be insufficient to effectually warm it; but there would of course be no difficulty in arranging a system of hot pipes around the ward, in the same way as is often done in parallelogram-shaped wards. Again, in a large ward I should be disposed to use a detached stove with large heating power obtained either by gills or plates of iron, or by hot water pipes supplied from a small circulating boiler behind the fire in the manner recently patented by Mr. Saxon Snell.

In a small ward it would probably suffice if a good double-fronted stove were provided in the centre of the ward, with either a downward flue carried under the floor or a vertical flue.

Upon the question of cost of construction of circular ward blocks there is much to be said. The quantity of walling in a circular ward is (as has been shown by Professor Marshall and is illustrated in Figs. 6 and 7) less than in a parallelogram-shaped ward for a corresponding number of beds; and although its circular form might perhaps make

the actual cost of construction slightly more than that of straight walls, there would on the whole be a saving in this respect. The quantity of flooring in a large circular ward being greater than in a corresponding parallelogram-shaped ward, would involve some additional cost; while the construction of the floor of a circular room of large diameter would be more complicated, and therefore somewhat more costly than that of an ordinarily shaped ward. In the same way the cost of roofing a circular ward would be greater than that of the simple span roof of a parallelogram building. Wards of ordinary shape are usually about 24 feet wide, rarely exceeding 30 feet in width, and hence it is always possible to frame a roof or a floor of such bearing in a simple manner; but when the space to be roofed or floored is circular, and of considerable diameter, it would be expedient to introduce intermediate bearings. This might be done to a certain extent by utilising the central chimney stack as a means of support; and in the case of the largest size circular wards, iron columns might be needed between the external wall and such central support. By the use of iron girders radiating either from the central chimney stack or from columns as supports at one end to the external wall at the other end, with rolled iron joists and Dennet (concrete) arching between them, an excellent and incombustible floor would be formed, on which an oak or other wood surface could be provided. It would not be expedient, I think, to make the ceiling of a large circular ward uniformly flat; because in a large room such a ceiling might possibly diminish the apparent height of the ward and give it a depressing effect. If the soffit of the arching and the lower portion of the girders were exposed, the appearance of one large expanse of ceiling would be avoided; and I do not doubt that, by the use of judiciously chosen tints, the whole of such a ceiling might be made to have a fairly satisfactory effect. Ceiling, floor, and roof construction, however, of the sort here suggested, must be expected to be more costly than the ordinary floors and roofs of simple parallelogram-shaped ward pavilions.

The construction of the flat roof of a circular block of

wards would follow very closely what I have just described for the floors, except that it would be covered with lead or asphalte or other similar material. If a slated roof were decided on, the arching might be dispensed with, and either a wooden or an iron structure formed in lieu thereof, to give the slates the requisite pitch and to hold up the necessary ceiling of the ward immediately beneath. This would be a somewhat less expensive mode of construction, but the advantage of being able to use the flat roof as a place for air and exercise for the convalescent patients would be forfeited.

There is but little else to say regarding the construction of circular wards in the very general remarks to which I am limited by the length of this Paper; but I may observe in reference to the relative cost of curved or circular work to plain or straight work, that in ordinary circular wards the window sashes and frames, the glass, and the doors would of course not necessarily be curved. The window sills and the lintels of the windows and doors however would follow the curve of the external wall; but inasmuch as these might be made of concrete cast in moulds, as is now frequently done in the case of large buildings, the cost of them would not differ from that of similar work in ordinary shaped pavilions. Upon the whole I think that the difference of cost between a circular block of wards and an ordinary pavilion, for a corresponding number of beds, with equal wall space per bed, would be but slightly in favour of the straight building.

It now only remains for me to say a few words regarding the appearance of a circular block of wards. Perhaps it will be enough for me here to refer to the favour which circular buildings seem to have found with artists from remote times down to the present day. Whether we look at the Castle of St. Angelo or the tomb of Cecilia Metella at Rome, the Baptistry, or even the Leaning Tower at Pisa, the curved apses of many churches, or the Albert Hall at South Kensington, I do not think we shall find much difference of opinion as to the satisfactory appearance of which the circular or elliptical form of building is capable. The building may be enriched by recesses, alcoves or balconies, or it

may be quite plain, but the circular form of itself may be trusted always to produce charming effects of soft light and shade. In fact, the circular form of hospital ward, in skilful hands, would lend itself in the most happy manner to the production of buildings which would undoubtedly be the pride of the towns possessing them.

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